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Supreme Court, U.S.
FILED

MAY 14 2002

OFFICE OF THE CLERK

No. 01-1421

In The

Supreme Court of the United States

KEVIN MCKEOWN

Petitioner,

vs.

THE DELAWARE BRIDGE AUTHORITY, et al.,

Respondents.

On Petition for a Writ of Certiorari to the United States Court of Appeals for the Second Circuit

SUPPLEMENTAL BRIEF

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TABLE OF CITED AUTHORITIES

Cases:

Whitman, EPA, et al. v. American Trucking Association, 531 U.S. 457, 121 S. Ct. 903 (decided February 27, 2001)

Acts of Congress:

Clean Air Act ("CAA")

TABLE OF APPENDICES

APPENDIX A:

STUDY: A MODEL OF THE TOTAL COST OF HIGHWAY TOLL COLLECTION BY PROFESSORS PETERS AND KRAMER

SUPPLEMENTAL BRIEF FOR PETITIONER

The petition demonstrates that lower court findings in this case create a conflict with Whitman, EPA, et al. v. American Trucking Association, 531 U.S. 457, 121 S. Ct. 903 (decided February 27, 2001) and with provisions of the Clean Air Act. Since the filing of this petition, petitioner has been made aware of an important study (Appendix "A") by Professors from The City University of New York and Kutztown University of Pennsylvania which indicates that toll booths ***create*** significant amounts of pollutants in violation of The Clean Air Act.

1. Respondents do not dispute their violations of The Clean Air Act, that a conflict exists that requires this Court's full consideration or that this matter greatly affects the health and welfare of vast amounts of U.S. citizens. Further, respondents consented to Professors' Peters and Kramer request to present this study to this Honorable Court. In short, the importance of the question presented is essentially unchallenged.

2. As this Court observed in Whitman, EPA, et al. v. American Trucking Association, Congress intended to protect the public without cost concerns and expressly provided that the best technology available be utilized.

3. Toll booths violate The Clean Air Act when they slow and otherwise impede the movement of toxic substance emitting vehicles and *unnecessarily add to* environmental pollutants. As in Whitman, EPA, et al which affirmed a Court of Appeals finding that §109(b) of the Clean Air Act ***unambiguously*** bars cost considerations, the current operation of toll booths must stopped.

4. This case presents important questions which impact the health, welfare and civil rights of every citizen of the United States, and is not limited to the states in which toll booths operate.

CONCLUSION

Accordingly, Petitioner respectfully prays that this Honorable Court grant the petition for Writ of Certiorari.

Respectfully submitted,

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A Model of the Total Cost of Highway Toll Collection

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Presented at
Eastern Economics Association Annual Meetings
February 2001
New York, New York

Appendix A-1

Forthcoming in the Proceedings of the 24th Annual Conference of the Association of Pennsylvania University Business and Economic Faculties October 2002.

A Model of the Total Cost of Highway Toll Collection

Introduction

Air quality and greenhouse gas emissions are important issues around the world. Most solutions to air quality issues have some type of negative economic impact such as monitoring costs and/or constraints on economic growth. One potential means of emission control that does not have a negative impact on economic growth is improved toll collection on toll bridges and roads. The traditional manual collection method causes motorists to decelerate from, and reaccelerate to, highway speeds. This, combined with the affects of queuing at toll plazas during peak travel periods, results in significant environmental costs. However, current models of the cost of toll collection do not account for these costs and therefore significantly underestimate the benefits to society of improved toll collection. We propose extending current models to account for these environmental costs.

Literature Review

Prior research on toll collection has focused on the compliance and administrative costs of the collection process. Vickrey (1963) is the first to outline a theory of the optimal pricing of road networks. Arnott, de Palma and Lindsey (1997) extend the Vickrey model by creating a structural model of road congestion that considers congestion technology and behavioral decisions of drivers in determining optimal toll pricing. Sheila and Wilson (1991) consider the idea of optimal tolls and the deadweight loss to society created by traffic delays resulting from the toll collection process.

Friedman and Waldfogel (1995) and Burris and Hildebrand (1996) document some of the major issues related to the administrative and compliance costs of toll collection. In addition, Friedman and Waldfogel (1995) measure these costs using a case study of a Massachusetts Turnpike toll plaza and data from the New Jersey Turnpike Authority. While all of these studies address the cost issues that are important to administrators, they ignore the environmental costs.

In this study, we extend the Friedman and Waldfogel (1995) model by adding variables that measure the environmental impact of toll collection. We then use this model to calculate the total societal cost (TSC) of

toll collection on the Garden State Parkway (GSP) in New Jersey using Sisson's (1995) estimates for automobile emissions, and the New Jersey Highway Authority's traffic volume estimates. Our results clearly indicate that the environmental cost of toll collection is significant and should be included in any measure of total collection cost.

Methodology

The total cost of toll collection is equal to the sum of the administrative, compliance, and environmental costs. The Friedman and Waldfogel (1995) model measures the administrative and compliance costs. According to their model, administrative costs (AC) incurred during time t are equal to:

$$AC_t = w_T L_t + u_t K \qquad (1)$$

Where w_T equals the cost of operating a tollbooth per time period, L_t is the number of tollbooths staffed and operational during time period t, u_t includes the user cost of toll collection capital (including both borrowing and depreciation) per time period, and K equals the value of toll collection capital. Therefore, over any

extended period of time (for example, a year) administrative costs equal:

$$AC = w_T \sum_{t=0}^{T} L_t + K \sum_{t=0}^{T} u_t \qquad (2)$$

Compliance costs (CC) are measured as wQ, where w is the value of the road user's time and Q is the total amount of time the driver (assuming no passengers) is delayed in compliance:

$$Q = \sum_{t=0}^{T} \left(2fd + \frac{q_t}{L_t \alpha} \right) a_t \qquad (3)$$

where fd equals the fixed delay, q_t equals the number of vehicles in the queue at time t, L_t equals the number of lanes staffed at time t, α equals the number of vehicles that can be processed per lane per time period, or the throughput rate, and a_t is the number of vehicles arriving per time period. Therefore, according to this model, total collection costs (TC) equal:

$$TC = AC + CC \qquad (4)$$

However, as Sisson (1995) points out, the process of toll collection creates a significant amount of additional pollution as compared to transit at highway speeds. This is not accounted for in equation 4. To calculate

the pollution cost per pollutant x (PC_x), we use the following equation:

$$PC_x = (fp + (vp\ r_x))p_x \qquad (5)$$

where fp equals the fixed acceleration pollution of pollutant x per toll collection, vp equals the queuing pollution of pollutant x, r_x is the average rate of production of pollutant x per time period, and p_x is the cost of pollutant x to society on a per unit basis. Total pollution cost (PC) is equal to:

$$PC = \sum_{x=1}^{m} PC_x \qquad (6)$$

where m is the total number of pollutants being measured. We add this variable to the right-hand side of equation 4, that we call the total societal cost of toll collection (TSC):

$$TSC = AC + CC + PC \qquad (7)$$

Case Study: The Garden State Parkway

New Jersey's Garden State Parkway (GSP) is 173 miles long and has eleven major toll barriers and twenty ramp toll plazas. Based on data collected from the New Jersey Highway Authority we calculate the

total societal cost of toll collection on the GSP for the year 2000 using the model outlined above. Our goal is to demonstrate that when pollution costs are ignored, the total cost of toll collection is significantly understated.

Administrative Costs (AC)

The New Jersey Highway Authority estimates that administrative costs on the GSP (including the cost of capital and the labor costs of toll collectors and administrators) were $0.07 per toll collection in the year 2000. They also report 436,161,722 toll collections at the major toll barriers for the same year. Therefore, we estimate administrative costs to be $30,531,321 for the year 2000.

Compliance Costs (CC)

The Friedman and Waldfogel (1996) model was designed for use on a two stop toll road where the driver stops once to pick up ticket and then again to pay the toll. While this is consistent with many toll collection systems such as the NJ Turnpike and the Massachusetts Turnpike, on the Garden State Parkway, drivers stop repeatedly for the duration of the trip with a maximum distance of 24.76 miles and a minimum of 5.79 miles between major toll barriers. A driver following the whole route of the GSP would stop

at 11 barriers along the route. Therefore, we need to modify Friedman and Waldfogel's (1995) compliance cost function so that it calculates costs on a per stop basis: $CC_t = (fd+vd_t)w$ (8)
where CC_t equals the compliance cost at time t (per stop), fd equals the fixed delay, vd_t is the variable delay at time period t, and w equals the value of the road user's time. The Triborough Bridge and Tunnel Authority estimates that the theoretical maximum for the number of vehicles a tollbooth can process is 250 per hour. Based on this, we calculate the fixed delay as 7.2 seconds per car. With 436,161,722 toll stops occurring in the year 2000, at a delay of 7.2 seconds per stop, this totals 872,323 hours spent paying tolls. At an average wage rate of $20 per hour[1], this represents a total compliance cost (CC) of $17,446,469 for the year 2000.

Pollution Costs (PC)

We estimate the pollution costs related to toll collection on the GSP using Sisson's (1995) estimates of pollution production from decelerating an automobile to zero miles per hour and then reaccelerating to the same speed. Sisson (1995) examined three vehicle classes (pre-1979, 1980-1988, and 1989-1994) in his study and their corresponding production of Nitrous

Oxide, Hydrocarbons, and Carbon Monoxide. While

[1] The estimated wage rate is from the Bureau of Labor Statistic's 1998 estimate of the average income of New Jersey residents ($39,516). Dividing this number by a two thousand hour work year results in an average hourly wage of $19.75.

this was representative of the automobile population in 1995, our estimates of pollution production in 2000 are taken from the most recent period.[2] The fleet average output of pollutants for this cohort, per acceleration, net of what would be created by a quarter mile transit at 65 m.p.h., are given in row two of Table 1. Based on these estimates, the cost per kg of pollutant, and the total number of toll collections on the GSP during the year 2000, we estimate the total cost of pollution from toll collection at $12,702,011. With toll collection revenue on the GSP reported to be $152,656,602 for the year 2000, pollution costs represent 8.32% of revenue collected[3].

[2] Emission standards for Hydrocarbons, Carbon Monoxide, and Nitrous Oxide have remained constant for automobiles and light trucks since 1994. The Sisson (1995) data is attached as Appendix 1.

[3] Details of our pollution calculations are included in Appendix 2.

Table 1: Calculation of the Total Pollution Cost Resulting from Toll Collection on the Garden State Parkway (2000)

	Nitrous Oxide	Hydrocarbons	Carbon Monoxide
Grams emitted per 0-65 acceleration net of continuous 65 m.p.h. transit	0.63	0.85	32.25
Number of accelerations on the GSP	436,161,722	436,161,722	436,161,722
Total grams emitted on the GSP	272,601,077	370,737,464	14,066,215,548
Pollution cost per kg (Sisson 1995)	$11.81	$4.71	$0.55
Total pollution cost (PC) on the GSP	$3,219,419	$1,746,173	$7,736,419

This estimate is on the conservative side because we did not estimate the queuing costs for the GSP. Given that the commuter on the GSP currently has three payment choices – manual, exact change and *low-speed* EZ-Pass, and that traffic volumes vary greatly over the course of the day, estimating the costs related to queuing are very complex and beyond the scope of this study. Nevertheless, including queuing would only increase pollution costs as a percent of revenue collected, further bolstering our argument in favor of including pollution costs in the total cost equation.

Total Societal Cost (TSC)

From equation 5, total societal cost represents the sum of administrative, compliance and pollution costs. In the case of the GSP in the year 2000, we estimate total societal cost of toll collection to be $54,566,340 or 39.75% of revenue collected (see Table 2), and pollution costs represent 20.93% of TSC, only slightly less than compliance costs.

Table 2: Component Costs as a Percent of Total Collections

Component	Revenue/Cost	Percent of Revenue	Percent of TSC
Revenue Collected	$152,656,602	100%	----
Costs:			
Administrative Costs (AC)	$30,531,321	20.00%	50.32%
Compliance Costs (CC)	$17,446,469	11.43%	28.75%
Pollution Costs (PC)	$12,702,011	8.32%	20.93%
Total Societal Cost (TSC)	$60,679,800	39.75%	100%
Net Revenue	$91,976,802	60.25%	----

Conclusion

Economists should not ignore pollution costs when estimating the total cost of toll collection. By examining the pollution costs on the Garden State Parkway we have shown that, even without measuring the environmental impact of queuing, pollution costs constitute 20.93% of the total societal cost of toll collection, or 8.32% of revenue collected.

The model we develop in this paper will assist public policy makers in making optimal decisions regarding toll collection procedures. For example, the cost estimates in this paper are based on a one hundred percent manual toll collection process.[4] If high speed, automated toll collection procedures were implemented, or if tolls were partially or completely eliminated, we would expect pollution costs to decline significantly. These types of policy issues can only be properly analyzed if all costs/benefits are accounted for, including those regarding the environment.

[4] The GSP is currently only using a low speed collection method, which our research indicates results in almost the same amount of pollution as manual toll collection. See our kinetic energy calculations attached as Appendix 3 for further details on the loss of energy caused by the slowing of vehicles in toll plaza.

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Appendix 1

Pollution Production from Automobile Operation

Average Driving Cycle (FTP Cycle)

Emission Rates in Grams Per Mile (Sisson 1995)

	Nitrous Oxide	Hydrocarbons	Carbon Monoxide
New Cars (1989-1990)	0.50	0.40	3.00
Older Cars (1969-1979)	4.80	10.70	62.40

Grams Emitted Per 0-65 Acceleration by Car Age (Sisson 1995)

Car Age	Nitrous Oxide	Hydrocarbons	Carbon Monoxide
1989-1994	0.75	0.95	33.00
1980-1988	2.36	7.07	196.00
1979 and Older	7.20	25.41	686.00

Fleet Average for One 0-65 MPH Acceleration (Sisson 1995)

	Nitrous Oxide	Hydrocarbons	Carbon Monoxide
"Fleet Weighted Average"	2.21	6.50	181.00

Appendix 2

Impact of Full Stop Manual Toll Collection on Grams of Pollution Output

Delta for One Full Stop at Toll Plaza Versus High Speed Automated Toll Collection

Event	Grams of Nitrous Oxide	Grams of Hydrocarbons	Grams of Carbon Monoxide
1/4 of Mile Transit (#1)	0.13	0.10	0.75
0-65 Acceleration (#2)	0.75	0.95	33.00
Delta for Stop at Plaza (2-1)	0.63	0.85	32.25

Number of Transits - Major GSP Toll Plazas in 2000 **436,161,722.43**

Total Grams Annual Pollution Produced	Nitrous Oxide	Hydrocarbons	Carbon Monoxide
	272,601,077	370,737,464	14,066,215,548
Tons	299.86	407.81	15,472.84

Pollution Costs (Sisson 1995) Per Kilogram	Nitrous Oxide	Hydrocarbons	Carbon Monoxide
Price per Kilogram	$ 11.81	$ 4.71	$ 0.55

Total Annual Pollution Costs - 11 Major Barriers on Garden State Parkway	$ 3,219,419	$ 1,746,173	$ 7,736,419	
	Total Pollution Costs	$ 12,702,011	For Year 2000	

Appendix 3
Energy Conservation - Estimated
Comparison of Alternative Toll Collection Speeds

Automobile Weight (lbs)	Automobile MPH Speed	Automobile Mass Kilograms	Automobile Speed Meters Per Second	Kinetic Energy $KE=1/2\ MV^2$ joules	55 MPH Energy Percentage
3,000	65	1,360.8	29.06	574,491.7	139.67%
3,000	60	1,360.8	26.82	489,507.8	119.01%
3,000	55	1,360.8	24.59	411,322.5	100.00%
3,000	50	1,360.8	22.35	339,935.9	82.64%
3,000	45	1,360.8	20.12	275,348.1	66.94%
3,000	40	1,360.8	17.88	217,559.0	52.89%
3,000	35	1,360.8	15.65	166,568.6	40.50%
3,000	30	1,360.8	13.41	122,376.9	29.75%
3,000	25	1,360.8	11.18	84,984.0	20.66%
3,000	20	1,360.8	8.94	54,389.8	13.22%
3,000	15	1,360.8	6.71	30,594.2	7.44%
3,000	10	1,360.8	4.47	13,597.4	3.31%
3,000	5	1,360.8	2.24	3,399.4	0.83%
3,000	0	1,360.8	-	-	0.00%